RESEARCH CIRCULAR 5 MAY, 1950

# CONTOUR FENCING

OHIO AGRICULTURAL EXPERIMENT STATION
WOOSTER, OHIO

in cooperation with
U. S. Soil Conservation Service, Coshocton, Ohio

**The Cover**

Contour fencing has proved both satisfactory and practical. This fact will change many landscapes to appear as the one illustrated here since livestock control on contoured farms has been a major problem.

This contoured and fenced hillside is located on the North Appalachian Experimental Watershed at Coshocton, Ohio.

# CONTOUR FENCING[1]

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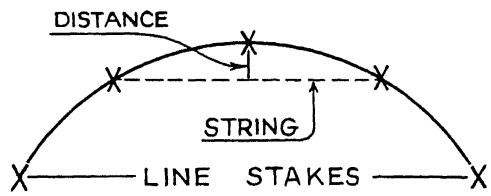
Soil and water conservation programs in many areas have introduced into farming practices contour cultivation, terraces, diversion ditches, and the like — curved lines on curved land. Fence lines involving the least amount of post bracing, waste land, and short point rows must likewise fit the curved-line farming. Such construction introduces new problems, the most important of which are: (1) spacing of posts and (2) tension or pull in stretching the wire fence. In order to find the answer to these and other curved fence questions, a research program was started in October, 1947 at the North Appalachian Experimental Watershed of the U. S. Soil Conservation Service near Coshocton, Ohio.

Results of these tests over a 2- to 3-year period suggest certain rules for building fences on a curve. The tests were made with woven wire fence 47 inches high having No. 9 wire top and bottom and No. 11 filler, one barb wire 2 inches above, and steel fence posts. Whether the results are applicable to all types of wire fence on curved lines or different soil types must await further research. A detailed description of the experiment is given in the latter part of this circular. Recommendations based on this experiment are given as follows:

1. *Spacing line posts—*
    a. Stake out a smooth curve along the contour strip or terrace spacing stakes 16½ feet apart.
    b. Check the curvature of the fence line at different points to determine if posts will have to be spaced closer than 16½ feet. Select three consecutive stakes in any fence section. Stretch a string between the first and the third stakes. Measure the distance from the center stake to the string as illustrated in Figure 1. Repeat this operation

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wherever the curvature appears to change appreciably. If this distance is 4 inches or less, the fence posts can be put in at the stake spacing — 16½ feet apart. If this distance is greater than 4 inches the posts should be spaced closer than 16½ feet. Spacing of posts where curvature of the fence line makes this distance to the string greater than 4 inches is given in Table 1.

**Table 1.—Table of Recommended Post Spacings**

| Distance of center stake to string | Recommended post spacing |
|---|---|
| Inches | Feet |
| 4 or less | 16½ |
| 4 - 5 | 15 |
| 5 - 6 | 14 |
| 6 - 8 | 12 |
| 8 - 14 | 10 |
| 14 - 20 | 8 |

Example: If this distance of the center of three consecutive posts measured 5½ inches, the line posts should be spaced 14 feet apart. If the distance were 10 inches, the post spacing would be 10 feet.

c. Replace the stakes at the proper spacing as defined by Table 1 and check by eye to see that no single post is out of the line of a smooth curve. Fence wire should then pull equally against each post.

d. Steel posts should be 6½ feet long with the usual brace plates. Other line posts should be 7 feet long.

2. *Setting posts—*

When driving or setting posts, lean the top out approximately 2 inches. When the wire is stretched the posts will tend to straighten up to a plumb position.

3. *Placing wire—*

Always put wire fence on the outside of the posts on the curve so it pulls against the posts.

4. *Stretching wire—*

Fasten end of roll to end post and roll wire out on ground along fence line. Pull wire up by hand until it clings up against fence posts. Attach stretchers and pull up wire fence to proper tension. Stretch to only a moderate tension as a curved fence needs much less tension than a straight fence. The sharper the curve the less tension should be applied. When stretching the fence, go along it several times releasing it where it catches on the posts. On sharp curves it may be necessary to stretch in 10-rod sections,

otherwise, 20- to 40-rod stretches are satisfactory. When curvature changes materially it will be desirable to start a roll of fence at the sharpest curvature and apply stretchers at the end of less curvature. In this way, the wire in the sharper curve will have less tension.

Construction of contour fences is not difficult, in fact it is easier than building a straight fence which goes over uneven ground. This is because when a fence is built on the contour, tension of top and bottom wires are equal and also there is no tendency to lift posts as there is in crossing a low spot.

## THE EXPERIMENT

The preceding recommendations for construction of contour fence are based on experiments started at the Soil Conservation Service Research Station near Coshocton, Ohio in the fall of 1947. The purpose of this program was to determine practical methods of constructing contour fencing. This type of fence is of great value in contour farming and strip cropping as it serves as permanent contour markers, permits pasturing of the fields at times, and prevents waste corners of fields. At the time this experiment was started, there was no available research data as to methods or results of building contour fences.

In planning this, the following variables were introduced to evaluate their effect on curved fences:

1. Different radii of curvature.
2. Different spacing of the posts.
3. Different tensions.
4. Use of extra brace plates in the ground.
5. Concave and convex curvatures up hill.

The soil where this fence is built is mostly Muskingum silt loam with some Keene silt loam. The entire curved fence with connecting straight sections encloses a pasture lot of approximately ten acres seeded to an alfalfa-Ladino clover-bromegrass mixture. Most of the area outside this lot is also pastured with beef cattle. The experimental fence is, therefore, pastured on both sides, but not at the same time.

### Construction

MATERIALS: Fence is 47-inch hinge-joint woven wire. Bottom and top wires are 9 gauge with 11 gauge filler, 6-inch stays. Barb wire is 12½ gauge, 4 point, with the barbs 5 inches apart. This is one of the most popular types of fence in the Coshocton area.

Posts are standard U shaped steel posts. The 6½-foot posts weigh 9½ pounds.

Extra brace plates were used on some sections (Fig. 1). Details of these plates are shown in Figure 2.

End posts are 3 x 5 inch angle irons set in concrete and guyed to underground concrete blocks with ¾-inch threaded iron rods.

METHODS: The fence line was staked out on the exact radius given in Figure 1. A steel tape was used to measure from center point on the short radius sections A, B, E, and F and a transit on sections D, G, G′ and G″.

End posts were set in concrete and guys drawn up tight after the concrete had set. Line posts were driven with the top leaning out from the center of curvature. This inclination was ¼-inch per foot of height.

| Section | No. Line posts | Distance between posts (feet) | Radius of curve: Length (feet) | Radius of curve: Center point | Extra brace plates | Tension before stretching barb (Lbs.) |
|---|---|---|---|---|---|---|
| A | 14 | 10 | 113 | Up hill | Yes | 790 |
| B | 14 | 10 | 113 | Up hill | No | 790 |
| D | 12 | 16-1/2 | - | Straight | No | 1,300 |
| | 20 | 16-1/2 | 922 | Up hill | | |
| E | 18 | 12 | 221 | Up hill | No | 1,300 |
| F | 18 | 12 | 221 | Up hill | Yes | 1,300 |
| G | 25 | 16-1/2 | 490 | Down hill | No | 1,300 |
| | | | 450 | Up hill | | |
| G' | 25 | 16-1/2 | 490 | Down hill | Yes | 1,300 |
| | | | 450 | Up hill | | |
| G" | 35 | 12 | 490 | Down hill | No | 1,300 |
| | | | 450 | Up hill | | |

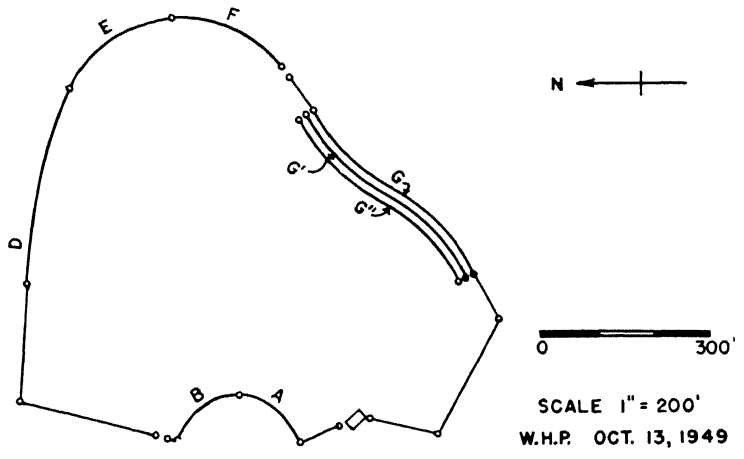


**Figure 1. Experimental Layout of Contour Fence**

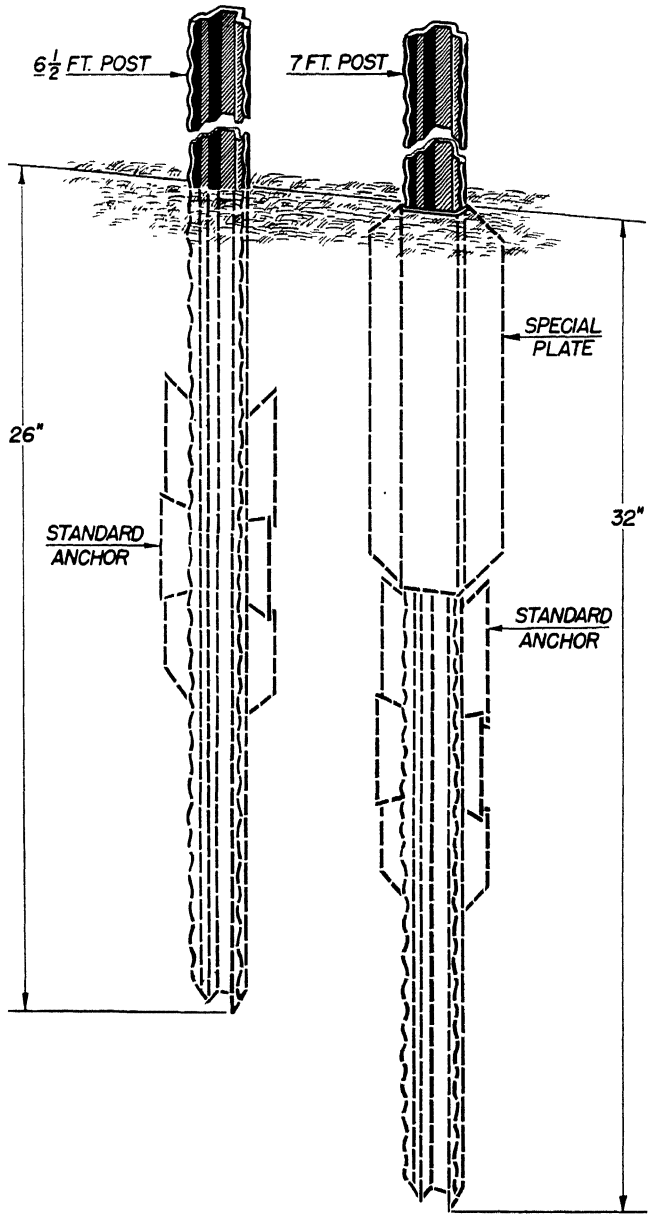


Figure 2. Standard and Special Brace Plates on Fence Posts

A carpenter's plumb, with an attachment at one end, was used to set the posts to the desired inclination. The woven wire was unrolled and the end at which tension measurements were to be made was wrapped around a piece of 3-inch pipe as shown in Figure 3. This pipe was fastened to the end post with long threaded bolts. This permitted the insertion of a hydraulic jack for measuring tension. Regular fence stretchers were then attached to the opposite end and the fence stretched to almost the desired tension. After the end at the stretchers was fastened to the end post, the desired tension was then obtained by adjusting the tension bolts between the pipe and end post as shown in Figure 3. The top and bottom bolts were adjusted so that the tension on each was identical. After measurements had been made of tension and post positions the barb wire was stretched. Another set of measurements were made after stretching the barb.

### Measurements

TENSION: Tension was measured by placing a hydraulic pulling jack between the 3-inch pipe to which the fence was attached and the end post. This is shown in Figure 3. This jack was equipped with a calibrated pressure gauge so the actual tension in pounds could be calculated. The accuracy of this method is within 50 pounds. Due to the clinging of the wire to the post a more accurate method does not seem practical. It will be noted in the table in Figure 1 that the maximum tension used was 1,300 pounds which is approximately two-thirds of the tension usually applied on straight fences.

**Table 2.—Contour Fence Data**

| Section | Date built | Tension | | | Average deflection[2] of line posts | |
|---|---|---|---|---|---|---|
| | | Original[1] | 2–20–50 | Percent of original | Bottom | Top |
| | | Pounds | Pounds | | Feet | Feet |
| A | Nov. 16, '48 | 790 | 370 | 47 | −0.013 | −0.037 |
| B | Nov. 17, '48 | 790 | 370 | 47 | − .012 | − .037 |
| D | Dec. 22, '47 | 1,300 | 1,630 | 125 | + .004 | − .034 |
| E | Dec. 5, '47 | 1,300 | 790 | 61 | − .027 | − .108 |
| F | Dec. 5, '47 | 1,300 | 665 | 51 | − .012 | − .086 |
| G | Nov. 16, '48 | 1,300 | 940 | 72 | − .004 | − .047 |
| G' | Nov. 22, '48 | 1,300 | 875 | 67 | − .004 | − .031 |
| G" | Nov. 22, '48 | 1,300 | 960 | 74 | − .015 | − .048 |

[1] Original tension is total tension of top and bottom measurements after woven wire was stretched and before barb was stretched.

[2] In measuring deflection, a negative movement is one towards the center of curvature. Measurements given for deflection are those from position of the post as measured immediately after stretching the woven wire.

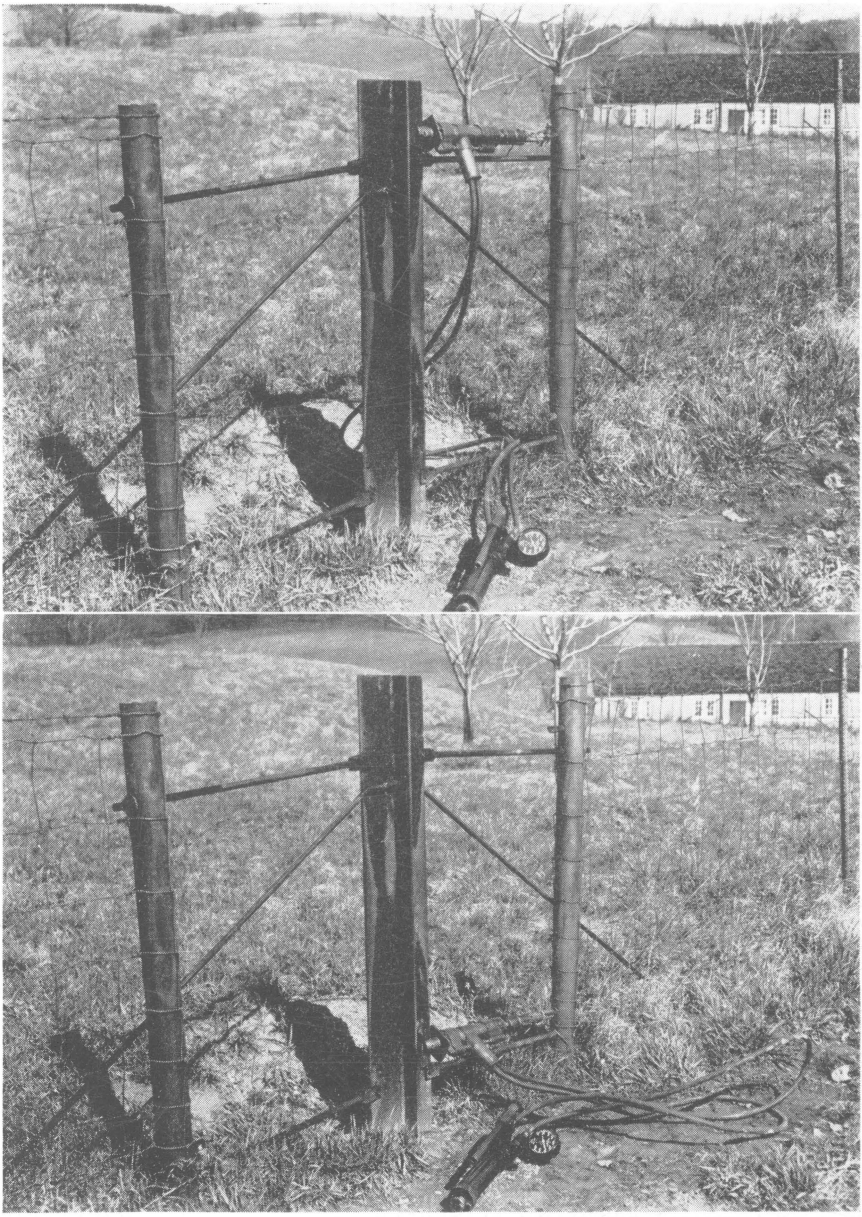

Figure 3. Method of Measuring Tension in Fence

DEFLECTION: Position for measuring changes in position of the posts was made by driving a 30-inch steel rod flush with the ground surface 4½ feet from the base of each line post on a radial line to the center of curvature. Center punch marks on this rod and on the post at top and near ground line provide exact points for measuring deflection. This is shown in Figure 4. Similar rods in fence line near the end posts are provided to show any change in position of end posts.

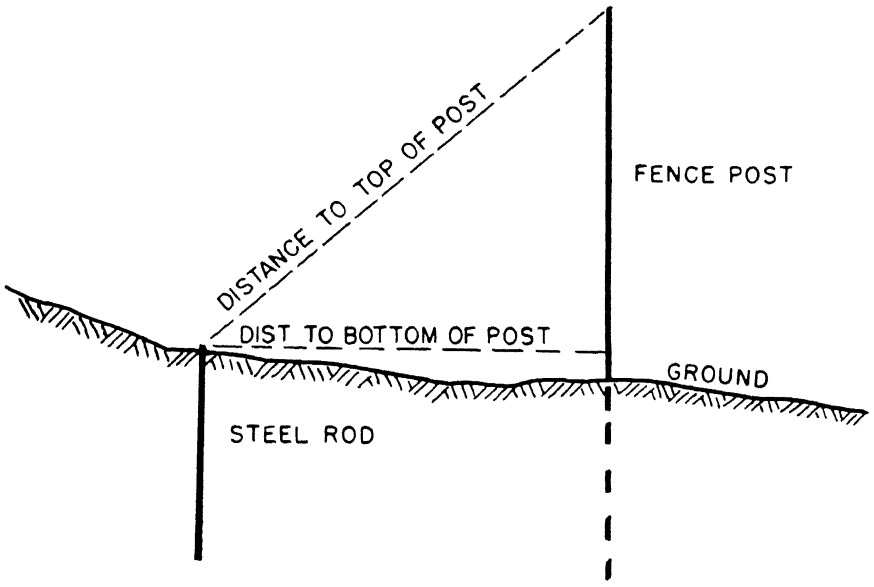


FIGURE 4.- METHOD OF MEASURING POST DEFLECTION

RESULTS: All sections of the experimental fence appeared to be in excellent condition in the spring of 1950. Data in Table 2 show there has been some slackening in tension, except in section D, and a slight deflection of the tops of the posts. Measurements at the end posts show no movement of these posts, hence, all changes in tension must have been the result of either shift in position of line posts, the fence changing in length by expansion or contraction of the tension crimps, or of temperature expansion or contraction of the wire in the fence. These changes are not apparent to the eye and the curved sections seem to be in as good condition as the straight sections connecting them.

Experimental evidence to date shows little or no justification for the use of the extra brace plates or for placing the posts closer than recommended.

It is probable that in sections E and F less tension on the fence might have been desirable.

This is a progress report. It is realized that this experiment should be continued for a period of from 5 to 10 years longer so that more substantial results could be obtained on the life of curved fences. The results and recommendations presented herein are based on short-term observations, yet the cooperating parties were impressed with the need for the immediate release of such information to the public. Future findings will be published to augment those contained herein.